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ABSTRACT

The economic implications of new technology in public libraries include its cost, the trade-off between costs and benefits, and sources of funds. The cost of, for example, a new terminal, should be subdivided into components and activities so that library expenditures and some resultant output can be clearly identified. In addition, when evaluating the costs and benefits of the acquisition of a terminal, it may be desirable not only to measure performance in terms of quality or quantities produced at that level of the system, but also to determine the effects that components, activities, products or services, functions, or the library have at higher levels. Costs and benefits are then expressed as input expenditures and output results in terms of performance, effectiveness, and higher order effects. Librarians often have to find alternative sources of funds for library technology, such as user charges. Factors to consider when instituting user charges include their effect on use of library services, the type of users served, the level of cost involved, the presence of alternative means of information retrieval, and the role of the library in society. This paper also briefly looks at the growth in the employment of librarians and other factors affecting the future of libraries and the information profession. Twenty-three references are listed. (ESR)

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# Implications: Economics of Technology on Public Libraries

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Overwhelming evidence suggests that the U.S. is rapidly moving from the Industrial Age to the Information Age. Yet the library community is said to be diminishing in importance and some have even predicted the demise of libraries by the end of this century. On the other hand, some sources of evidence refute this "doom and gloom" outlook and suggest that libraries and librarianship will continue to make important contributions to society. The library profession is increasing at about the rate of growth of the number of constituents served. Unfortunately, library budgets may be set by the size of the constituency served rather than by the rapidly increasing demands for information. Even so, librarians have been highly flexible in order to meet the economic requirements imposed over the last decade and have responded to this challenge through networking and resource sharing and by implementing new technology in libraries. This paper discusses the economic implications of using such new technology in public libraries.

The United States, and most industrial nations, have experienced a movement from an Agricultural Age to an Industrial Age and now to Information Age. About one hundred years ago about five percent of the workforce was engaged in the information sector and this proportion grew to about one-third in the 1950's and is estimated to be over one-half at the present time in the U.S.[1] This is truly a phenomenal occurrence with substantial implications to our economy, employment structure, social behavior and well being. Yet the same phenomenon seems to be happening in other industrial nations as well. For example, in Japan the information sector grew from 18 percent of the workforce in 1960 to 30 percent in 1975 and in the United Kingdom the growth was from 27 percent in 1951 to 36 percent in 1971.[2]

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It has been estimated that the U.S. population consumes about 7 trillion words a day through electronic media (e.g., radio and television) and print media (i.e., newspapers, books and magazines). However, the

words made available is growing much more rapidly (8.9% per year) than the words consumed (2.9% per year) thus yielding a glut of information.[3] Even though words distributed and used through electronic media are clearly replacing the printed media, it is believed that this is "news" and recreational information provided through television. Information used for professional and other purposes seems to still rely on the printed media. For example, publishers distribute nearly 3.0 billion copies of scientific and technical journal articles each year in the U.S. and the amount of information generated, disbributed and used is growing at about the same rate as the number of scientists and engineers.[4] It is thought that other professions also experience the same trends. The U.S. population in general continues to consume about 1.5 trillion words per day from printed media.

One wonders why, in light of the phenomenal growth of information and the information sector, the library community seems to be languishing. First of all, the library field may not be doing as badly as many suggest. A recent study[5] shows that the amount of librarian employment grew 8 percent in the four years 1978 to 1982. This represents a growth of about 1.6 percent per year, which may seem very low. Yet, when analyzed may not be as bad as it appears. The growth of the information sector (mentioned above) during the 1960's was only 3 percent per year. It was found that the growth in number of librarians closely follows the growth in the number of constituents whom they serve. For example, the number of public librarians grew about 3.3 percent from 1978 to 1982; whereas the population in the U.S. increased 4.3 percent during that time. The number of academic librarians grew 6.5 percent, which is somewhat greater than growth of student enrollment (2.2%) during this period. Similarly, the increase in number of school librarians seems to be greater than enrollement: 2.0

percent increase in librarians compared to 5.6 percent decrease in enrollement in public schools and 33 percent versus zero percent growth in non-public schools. The number of special librarians has increased a healthy 19.2 percent in the time period 1978 to 1982. One of the constituents of special librarians is scientists and engineers and those professions have grown 19.7 percent during the same period. Therefore, from the standpoint of constituents served one should not be surprized at the rate of growth of librarianship.

One problem is that the number of constituents served probably is the criterion used to set library budgets. This simplistic way of looking at things ignores some of the hard facts of library service:

(1) The information users are becoming more information intensive users (per capita consumption of words is growing 1.2 percent per year).

(2) The amount of words produced is growing about 9 percent per year or double every seven years. Traditional library materials doubles every fifteen or so years. Thus, libraries must store and provide access to an enormous accumulation of materials.

(3) The information hungry population is demanding larger collections as well as more kinds of services.

(4) Not only is the collection size of traditional materials rapidly increasing, but more types of information materials are desired by users (e.g., government documents, computer tapes, etc.).

(5) Libraries are being asked to provide access to new technology (e.g., online terminals) as well as information materials.

It is for these reasons that libraries have felt the economic tightening more than some of the other institutions. However, libraries have reacted marvelously well in coping with these problems. This is where new technology has entered the picture.

In order to achieve economics or produce more services with relatively fixed bugets, librarians have been highly resourceful through networking, employing new technology and reallocating resources to optimize services. In order to provide more extensive services, libraries have begun to reallocate budgets from materials to other services. For example, the proportion of budgets spent on materials of public libraries in 1977-78 was 14.6 percent and this has dropped to 12.7 percent in 1981-82.[6] One reason that this can be done without affecting overall services much is that libraries are distinguishing and acquiring only frequently used materials and relying on interlibrary borrowing for infrequently used materials. The breakeven point of purchasing versus borrowing of periodicals is in the range of ten readings per year and many libraries are cancelling subscriptions to periodicals that are less frequently read. (Yet some academic libraries are reported to have 25 to 30 percent of their periodicals under the breakeven point). In order to enhance interlibrary sharing of resources many networks have sprung up with automated systems designed to assist ILL through union listings and catalogs of holdings.

The great bibliographic utilities have also helped achieve enormous savings to libraries. Catalog networks such as OCLC have provided a means of reducing catalog costs through shared cataloging and they can provide many other bibliographic services as well from their databases. Online retrieval of bibliographic records in science, engineering, law, medicine,

and so on have also yielded substantial savings to libraries as well as in providing more accurate searching. Finally within libraries microcomputers have provided libraries the opportunity to perform many functions such as acquisitions, circulation, cataloging, security, accounting and so on at substantial savings. In fact, libraries are very close to having totally integrated library automation systems that can perform many of these functons from a single bibliographic record database. Some of the economic aspects of this new technology are discussed below.

There are several economic implications of new technology in public libraries including:

(1) costs of new technology,

(2) the cost and benefit trade-off of new technolgy, and

(3) sources of funds to support new technology.

Almost all decisions concerning new technolgy in libraries hinge on the amount of activity being performed such as cataloging, searching and so on. Because of the large initial costs and low per unit cost, it is found the low activity can be done less expensively by traditional or manual methods.

There are several levels and measures that must be thoroughly understood before economic analysis can be properly applied. At a specific level, there will be an input that one should be able to express in terms of dollar expenditures or other resources. For example, the input of a terminal (component) is the price paid plus all installation and maintenance costs; the input to cataloging (activity) is the expenditures and dollar costs related to all components associated with that activity; the

input to services or products associated with online bibliographic searching involves all expenditures directly related to its activities and their components; and so on all the way up to the entire library. The expenditures in all instances are the dollar values allocated in a budget to a component, activity, service or product, etc. On the other hand there are often direct resources that are not included as expenditures in a budget but can be conveniently converted to dollars and should be included, if possible. Examples might include line charges, some labor categories, supplies and so on. [7]

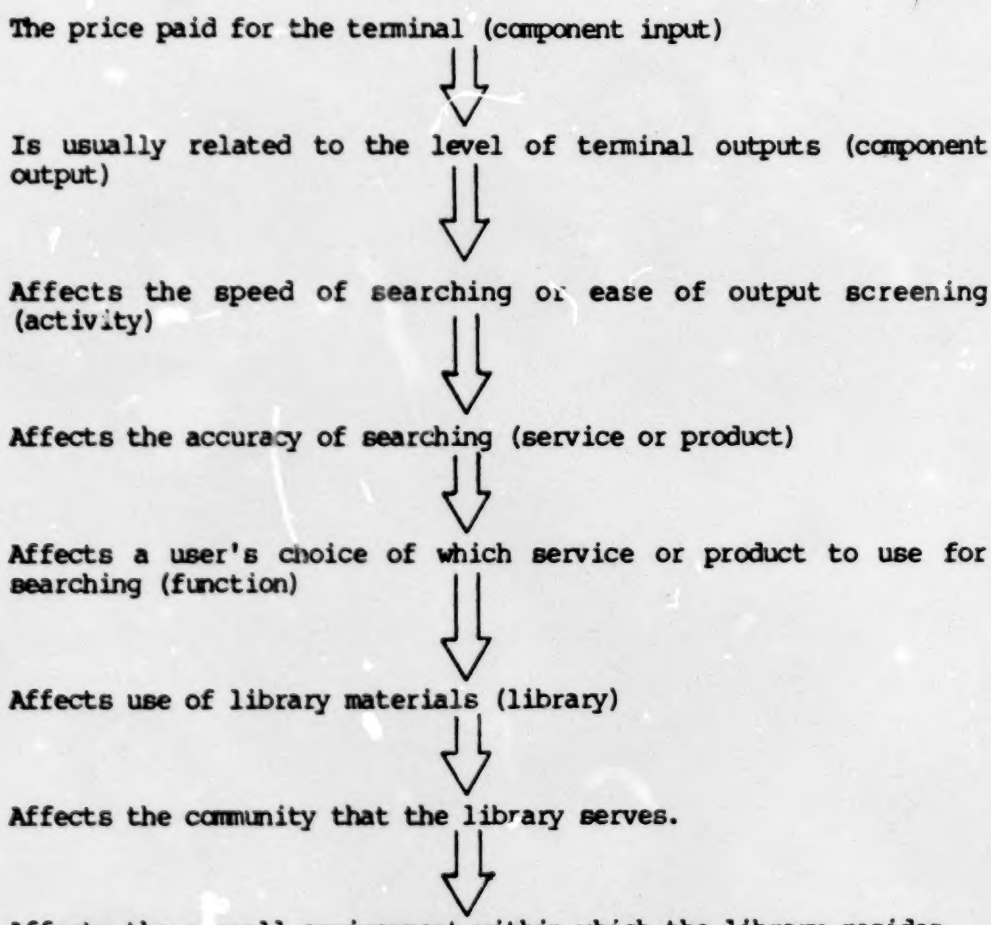
The result of sub-dividing operations into components, activities, ect. is that one can clearly identify their expenditures and also some resultant output as well. A cataloger produces so many catalog records at a certain quality; an online searcher performs so may searches at a desirable level of accuracy. Any level or measure of such output might be described by a component's performance which is usually described in terms of quantities produced and quality (e.g., accuracy, speed, etc.). Such performance measures should be elements of the cost and benefit as will be shown later. Often performance is described in quantifiable terms but not in dollars. For example, an online bibliographic searcher's performance might be measured by their average recall or precision. There are other important measures of output as well. These often are attributes of a service or product, or characteristics of an individual that result from the input expenditures and resources. Examples include convenience of a reference service location, or bookmobile; viewing resolution of a microform viewer, or video display; graphic quality of an online bibliographic computer printout; competence of an individual; and the like. Presumably greater expenditures (input) will yield better performance or attributes

(output). Comparing quantities produced to expenditures (e.g., catalog cards produced per person year of effort) yields productivity and comparing expenditures to other output measures might denote efficiency.

It is noted that the outcomes of decisions in terms of input (expenditures) or output (performance and attributes or characteristics) are all under direct control of the decision maker. Oftentimes, however, the consequences of these decisions cannot be directly controlled by the decision maker. For example, providing an online bibliographic search system will not ensure its use. However, level of performance and favorable attributes (along with high awareness and little or no charge) should increase its use. We refer to this second order effect as effectiveness. With user related services or products, it is measured from the perspective of the users. Effectiveness of services or products might be user satisfaction, cost savings to users, or number of uses made of the service or product. The cost effectiveness can be measured in terms of dollars, such as cost per use. There are also higher order effects of the use of library services and products. These include such things as improving education, research, management, entertainment, etc. depending on how the informaton is used. These higher order effects may also be incorporated in the cost and benefit calculus even though they often cannot be quantified.

The consequences of components and activities (particularly of those found in library operations functions and support functions) are less obvious. For example, in aquiring a terminal to do online searching one looks at the price of the terminal as input expenditures and the terminal's attributes (such as baud, display, etc.) as the result of the expenditure.

These attributes will affect online searching which is the effectiveness of the decision to acquire the terminal (as opposed to another with different attributes). Higher order effects can also be determined or at least asserted. The levels of cost and benefit of the acquisition decision can be shown as follows:


The price paid for the terminal (component input)
Is usually related to the level of terminal outputs (component output)
Affects the speed of searching or ease of output screening (activity)
Affects the accuracy of searching (service or product)
Affects a user's choice of which service or product to use for searching (function)
Affects use of library materials (library)
Affects the community that the library serves.
Affects the overall environment within which the library resides.

Thus, when evaluating the costs and benefits at any specific level, it may be desirable not only to measure performance in terms of quality or quantities produced at that level of the system, but also to determine the effects that components, activities, products or services, functions, or the library have at higher levels.

Cost and benefit analysis is an economic method to assist in making decisions concerning new technology. Such decisions might be about a library in its entirety, a function peformed by the library, a service or product, an activity or even a component. For example, decisions might concern whether (1) to acquire equipment (component), (2) regularly screen output of online searches (activity), (3) employ an online cataloging system or a manual system (function), and the like. The answers to such decisions almost always involve comparisons of alternatives, and the costs and benefits of these alternatives are the bases upon which to make these comparisons.

Costs and benefits should be described in terms of the unfavorable (i.e., costs) and favorable (i.e., benefits) outcomes of input and output, and consequences such as effectiveness and higher order effects mentioned in the previous chapter. If the outcome of a comparison is unfavorable at any of these levels it is recorded in a cost column. If the outcome of the comparison is favorable it is recorded in a benefit column. The trade-off between cost and benefit can be made by comparing all the items in the cost column against the items in the benefit column. The outcome of choosing between each alternative can be described in terms of their **costs** (i.e., dollar amounts associated with resource expenditures and other quantifiable and non-quantifiable detriments that occur as well), and **benefits** (i.e., dollar amounts associated with the favorable outcomes or consequences of choosing an alternative and other quantifiable or non-quantifiable benefits).

Thus, costs and benefits (of a component, activity, service or product, function or library) are expressed in terms of input expenditures

and other resources, and output results in terms of performance and attributes, effectiveness and higher order effects. However, costs and benefits are **not** measured as direct outcomes or consequences, but rather **in terms of comparisons** of components, activities, etc. Costs and benefits are measured by determining the unfavorable or favorable comparison of an alternative component, activity or service or product.

One aspect of new technology presents a problem to library directors. Computers and other equipment cost enough that they are given as a line item on library budgets. This often raises a red flag because of the amount or because many city officials have been burned by purchases of computers in other local environments. Therefore, librarians often have to justify the expenditure or they must find alternative sources of funds. Another aspect of new technology that affects funding considerations is the relatively large initial expenditure for purchasing and installing equipment compared to recurring annual expenses or operational expenses. Funding sources will depend to a large degree on the type and purpose of use of new technology.

There are two general situations in which new technology will be employed in public libraries. The first way will involve technology used for library technical operations such as cataloging, circulation control, acquisition control and so on. The second way will involve new services provided to patrons such as online bibliographic and numeric data searching, Videotex services, computer aided instruction and any type of facilities that can be of service to public library patrons. Another aspect that will dictate funding mechanisms will be whether new technology information products and services are provided entirely by the local public library (or

public library system) or by shared resources with other local libraries or regional networks. The new federalism program recently initiated by the Federal Government will also determine to some degree how new technology might be funded.[8]

It would appear that there are three sources of funds for the public library system. The first source is through local funds collected through taxes. The second source is through grants available through an intergovernmental grant system. The final method involves user charges for services provided by new technology. The latter method has been extensively discussed[9,10,11,12] is briefly summarized below.

King[13] has discussed some of the economic issues concerning user charges which are given below. Two principal questions must be answered when considering charging for library materials or services. First, who should pay for these materials and services? This seems to depend, at least to some degree, on who benefits from them. Clearly, at one end of the spectrum is the possibility that direct users should pay because they are the principal beneficiaries. At the other extreme is the philosophy that society should pay for library services through taxes, since everyone shares in the benefits provided by libraries. There are many possible variations and options to consider when deciding who contributes to or pays for library materials or services. The second question is how many each contributor should pay. Economists have applied these questions to many kinds of goods and services. They begin by classifying goods and services into categories which help to clarify the economic issues involved.

The first category of goods is for a private good. This includes goods such as food or cosmetics which primarily benefit the individual purchaser. There are two principal conditions of private goods. First, a person can be excluded from purchasing this type of good by either the price or the limited supply. Also, purchase (or use) of these goods must deplete their supply (i.e., there is one less apple in the barrel) and there is a cost associated with providing each unit purchased. Generally, it is felt that the user (and principal beneficiary) of private goods should pay for them. At the opposite extreme is goods used for a public good. In a purely economic sense, public goods benefit an entire community or society. Examples are the air people breathe, public parks, national defense, and scientific knowledge. Presumably, everyone benefits from these goods or services, use does not deplete their supply (i.e., one person using a park does not deplete its availability), the cost of each additional use is zero, and no one is excluded from their use or benefit. Everyone in society can benefit by scientific discovery in some areas; therefore, one can argue that the costs of pure science should be shared by everyone through taxation.

One aspect of requiring user charges is that they will affect the amount of use made of materials and services. King et al[14] make a strong argument that the value derived from information increases in direct proportion to the amount of use of the materials and services. The more that is charged, the less materials and services will be purchased and used, therefore reducing the value of the information. There is little question of the value of scholarly materials used in education, science, medicine and other professions. More use of these materials should yield substantial increased benefit to society. The same would hold, perhaps to a

lesser degree, for information used for recreational purposes. The option arises of giving away all materials or services in order to achieve maximum use of them and thereby achieving maximum value or benefit from them. One of the principal arguments used against this is that the materials and services may be ordered or used for frivolous or unnecessary purposes. However, even without a charge for materials or services, the users will incur a cost in terms of their time (which can be sustantial), and so they will not use materials or services as frivolously as implied by some. Generally, economists feel that maximum net benefit to society of materials and services is to charge a small amount, usually equal to the marginal cost of use or distribution.

It is important to make a distinction between information and new technology that adds value to the information through communication, display or some other function. The information may be like a public good but the property of new technology may be more like a private good. Certainly, this appears to be the case with online bibliographic services. Some factors to consider when deciding to charge for materials or services provided by new technology include who the users are, the cost of the materials or services, whether cost is incurred by the library for each use or is shared by all users, and whether there are other options available to the user within the library[15].

One factor that might be considered in deciding whether or not to charge for materials or services provided by new technology is who the users are. Cooper[16] discusses user charges for online searches provided by public libraries. He feels that professional users such as doctors, scientists, lawyers or businessmen should be able to pay for the service

and a charge should not have much bearing on whether or not they will use the service. It is not argued that the use by this population is not beneficial to society, but rather that value would not be lost because extensive use would be made whether or not a charge is made. He also suggests that users who do not contribute to revenue through taxes, such as residents of another town, should pay for online service. Videotex users, on the other hand, are likely to come from all walks of life and, therefore, may have less ability or inclination to pay. Thus, substantial benefit in using the Videotex systems would be lost through user charges.

Another consideration in whether to charge users or not concerns the level of cost involved. If the cost is very low, the cost of the process of charging could be greater than the revenue derived through charges. Such a problem is taken care of in photocopying by using coin operated machines. Another important cost factor is whether a cost is incurred by the library for each use. With online bibliographic and numeric data searches provided by public libraries this is certainly true. Even though most public libraries refer searches to other libraries (usually academic)[17,18] they are frequently charged for the search by those libraries. For searches performed in the public library, there are costs associated with equipment, labor, communication, connect time, database usage, and offline printouts and/or kits. Lynch[19] found that 72 percent of public library respondents to a 1981 survey charged online services. She found that most libraries charge for communication (60%), database usage (82%) and offline printouts (76%). Some public libraries charge for searcher time (21%) but only a few public libraries charge for annual costs (3%), overhead (10%) or other sources of costs (8%). It would seem that the fact that individual costs are incurred and private good is derived

from use of this new technology would suggest some form of charge. Services such as Videotex are not quite as straightforward regarding this factor, however. In this case, the use may not involve a cost per use or at most a minimal cost per use, if an in-house Videotex system is used.

Another consideration is whether there is an alternative in the library to using the materials or service provided by new technology. Presumably, online bibliographic searches could be conducted through printed indexes, which are more like a public good. Thus, users have a choice whether to search by each means. They would trade-off the savings in their time for using the online services against a user charge, if it is assessed. Also, another alternative is whether users chose to use librarians to conduct the search instead of conducting the searches themselves. Videotex systems probably would not have comparable alternatives

As Van House states, "A more subtle and perhaps more basic question suggested by libraries' experiences with online searching, however, is that of the role of the library in relation to future innovations in information technology. The growing importance of information in our society has resulted in the proliferation of specialized services that create, index, repackage, and deliver information. Many of these services have been made possible by developments in technology, which can be expected to continue to spawn new methods of information handling. What is the role of the traditional library in providing users with these new information services?"[20,21,22,23] Regardless of what kind of technology evolves over the years, the question of user charges is likely to prevail.

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